Colonic Sphincters Revisited: Simulators of Organic Disease

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Barium enema examinations establish the presence of neoplastic or inflammatory disease in the colon. Areas of narrowing commonly encountered appear to represent organic disease. These areas are in expected locations throughout the colon and have been described.[1-3] Not much attention had been given to these areas in recent literature, however, which has led to unnecessary colonoscopies and even surgeries.

The sphincters of Rossi, Balli, and Payr-Strauss are involved in nerve reflexes; the sphincters of Hirsch, Moultier, and Busi are a thickening of longitudinal and circular muscle fibers. Cannon's sphincter is an overlap of the superior and inferior mesenteric nerve plexuses. When an area of narrowing is encountered where a known sphincter is located, insufflation of more air, changing patient position, administering 2 mg of glucagon intramuscularly or 0.5 mg to 1 mg intravenously will aid in the distinction between a sphincter and organic disease.

Introduction

Barium enema examination of the colon is commonly performed throughout the world.

Recently, at both Tripler Army Medical Center and St Vincent's Medical Center, the authors encountered areas of persistent colonic narrowing in several patients which at first appeared to represent organic disease. As the procedure progressed many of these areas changed in appearance and demonstrated a normal mucosal pattern. These abnormalities are attributed to spasm, and when areas of narrowing occur in the expected locations that do not change, glucagon is administered intramuscularly or intravenously to relieve these areas of abnormal narrowing.

We became interested in these areas because many standard textbooks do not cover these transient abnormalities.[4-6] A literature search provided many articles detailing the location of various colonic sphincters (Fig 1); however, all were 20 or more years old.[1-3] The purpose of this paper is to retrospectively and prospectively review 500 barium-enema examinations to determine the frequency of the sphincters and to illustrate their varied appearance. Increased awareness of these sphincters will decrease errors in the diagnosis of organic colon diseases and prevent unnecessary intervention.

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Materials and Methods

Two days before the exam, all patients were placed on a clear liquid diet and given four 5 mg bisacodyl tablets to be taken orally, 2 a day at noon.

At 4 pm on the day before the exam, 296 ml of citrate of magnesium was ingested. The patients were to ingest nothing by mouth on the day of the test and at 6 am the patients were given a 10 mg bisacodyl suppository.

Double-contrast barium enema examinations were performed on all patients. Barium sulfate suspension was instilled to the mid-transverse colon and the barium bag was placed on the floor to drain the excess barium from the rectum and sigmoid colon. The patient was placed in the right lateral decubitus position to facilitate barium flow to the hepatic flexure. Once barium reached the hepatic flexure the patient was placed in the supine position and the table was tilted with the head up so barium could flow into the cecum. The barium bag was then clamped. At this time air insufflation was started in order to gain adequate colonic distention. Intermittent fluoroscopic monitoring was performed throughout all exams.

When adequate distention was achieved, routine fluoroscopic images of all quadrants were obtained with additional images if abnormalities were identified.

If a persistent narrowing was observed, and there were no

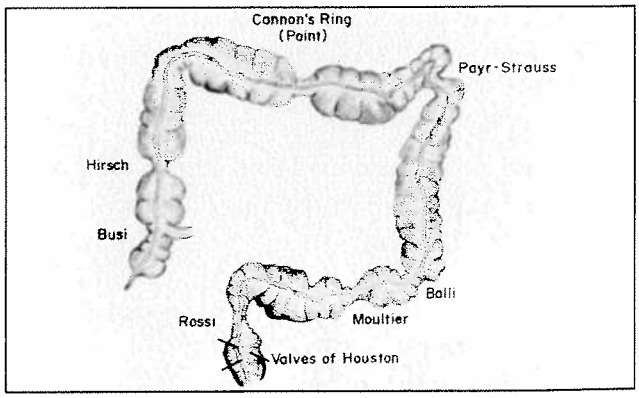


Fig 1.—Diagram of the location of expected sphincters.

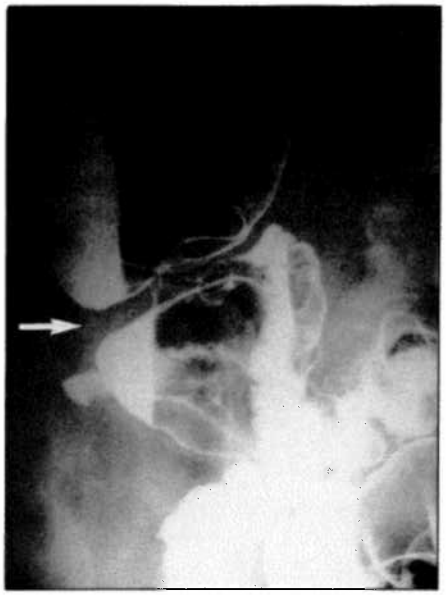


Fig 2.—(Left)The cecum has an abnormal coned appearance with barium present in the terminal ileum. With insufflation of more air, the cecum returned to its normal configuration.

Fig 3.—(Below) A spot radiograph of the cecum shows a somewhat focal area of narrowing present adjacent and superior to the ileocecal valve. The edges taper smoothly toward this narrowed region; the mucosa does not appear ulcerated.

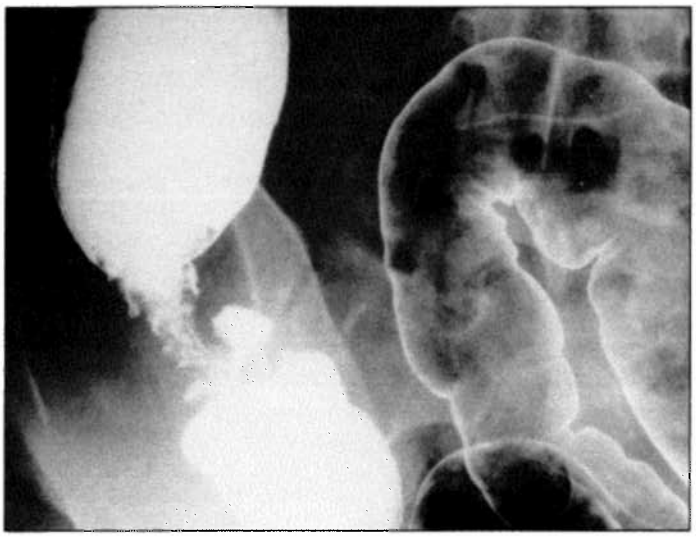


Fig 4.—Radiograph of the abdomen demonstrates a narrowed right colon with thickened mucosa similar to thumbprinting (arrow). Adequate distention proximal to this abnormality. In addition, multiple distal small bowel loops are filled with barium and appear to be normal. This abnormality resolved after glucagon administration.

contraindications, glucagon was administered 0.5 to 1 mg intravenously or 2 mg intramuscularly. If the narrowing did not resolve after additional insufflation of air and a change of position, the dose was repeated once.

Standard overhead radiographs of the abdomen were obtained in the supine, prone, right and left lateral decubitus views and lateral view of the rectum in the prone position with the catheter removed.

Barium enema examinations were reviewed by the authors as a group and consensus was reached in all cases as to the diagnosis of the presence or absence of a colonic sphincter.

Results

Retrospectively, 350 cases were reviewed and prospectively 150 barium enema examinations were reviewed. In these exams 83 (16.6%) patients had sphincters. Multiple sphincters were present in 15 (3%) patients.

Cannon's sphincter was identified most frequently, as seen in 45 (9%) patients, followed by Payr-Strauss in 26 (5%) patients. The sphincters of Hirsch and Busi were present in almost equal numbers, 10 (2%) and 9 (1.8%) respectively. Moultier's sphincter occurred in 6 patients (1.2%). Rossi's sphincter was seen in 4 (0.8%) and only 1 (0.2%) patient demonstrated the sphincter of Balli.

Discussion

The colonic sphincters (Fig 1) can be grouped according to similarities in structure or function. Muscular sphincters are true structural entities that result from an increased thickness in the longitudinal and circular muscle fibers. Examples of these are Busi, Hirsch, and Moultier sphincters.[1]

The functional sphincters of Payr-Strauss and Rossi demonstrate no changes in muscular arrangement or thickness and are caused by nerve reflexes.[1] With regard to the sphincter of Balli, debate exists as to whether a true histological difference exists in the muscular layer in the sphincter of Balli or whether this sphincter should be grouped with those that act solely in response to neural stimuli.[1,2]

Cannon's point, also known as the area of Cannon-Boehm, results from an overlap of neural plexi between the junction of the primitive midgut and hindgut which signals the change from an absorptive colon to a storage colon.[2]

The sphincter of Varolio is reported to be found at the apex of the ileocecal valve and represents a unification of circular muscular fibers, which in conjunction with the ileocecal valve, can act as a sphincter.[2] Other review articles do not mention this entity, and we were unable to diagnose this sphincter.[1,6-7]

The sphincter of Busi is seen 9 times in our review and commonly occurs as a smooth area adjacent to the ileocecal valve (Fig 2).

The sphincter of Hirsch occurred in 10 studies and has a variable appearance. This sphincter at times appears as a focal area of narrowing adjacent and superior to the ileocecal valve (Fig 3); at other times it involves long segments of the right colon to produce a coned cecum (Fig 4).

The patient in Fig 4 was evaluated for pain in the left lower quadrant and possible diverticulitis. Marked muscosal thickening and spasm were present in the right colon (arrow) even though the small bowel readily filled with barium and appeared normal. The patient stated that even during the exam there was no abnormal pain to the right side. Glucagon was administered intravenously in a 0.5 mg dosage that brought about prompt resolution of the abnormal-appearing right colon. This broad area with a variable appearance is consistent with the sphincter of Hirsch. In his original description, Hirsch stated this sphincter represents a vestigial strip of muscular fibers—the retinacular bands—that form the frenulae of the valves.[7] In this same article, Hirsch calls this area the cecocolic sphincteric tract, alluding to its lack of focality. He notes that both lower animals and humans have this sphincter, postulating it's importance in the retention of cecal contents for complex digestive changes to occur.

Cannon's point, first described in 1902 following animal experiments and later confirmed by Boehm, was present in 45 exams and is our most commonly diagnosed sphincter. This is a sphincter without any evidence of muscular thickening or abnormal accumulation of ganglion cells.[8] This sphincter represents the junction of the midgut and hindgut, a watershed zone of different innervations and vascular supply. Its appearance also is quite variable, and it can appear as a focal area of narrowing (Fig 5) or can involve longer regions of the transverse colon (Fig 6). In these cases, the narrowed regions have smooth, tapered edges without evidence of mucosal ulceration, and all remitted with change of position or insufflation of more air. The mucosa in Fig 6 has a feathery or wrinkled appearance.

To rule out an underlying colonic lesion, an elderly patient was evaluated who had a history of blood in the stool. A focal area of narrowing in the mid-transverse colon was identified that did not change throughout the exam even though insufflation of more air and the recommended change in patient position was performed (Fig 7). Glucagon was not administered, and the patient was discharged from the department with the preliminary diagnosis of a colonic neoplasm. As this area of narrowing is in the expected location for Cannon's point and no definite mucosal ulceration was present, the patient was reexamined the next morning and did not demonstrate evidence of the previously noted abnormality (Fig 8).

The Payr-Strauss sphincter in the splenic flexure was found in 26 patients and most commonly appeared as a long segmental narrowing or change in caliber extending distally to the sigmoid colon region (Fig 9). A focal area of spasm less commonly identified was found (Fig 10). This abnormal area is more commonly present when the bowel is underfilled with air.

The etiology of the Payr-Strauss sphincter, in which no histologic differences are present, results from the peristaltic rush that originates at this level during stimulation of the defecation reflex.[4,5]

The sphincter of Balli, present at the junction of the descending colon and sigmoid colon, was found in 1 patient (Fig 11). This patient's examination demonstrated a focal area of narrowing (arrow). As noted earlier, debate exists as to whether histologic abnormality exists to account for this abnormality.[4-5]

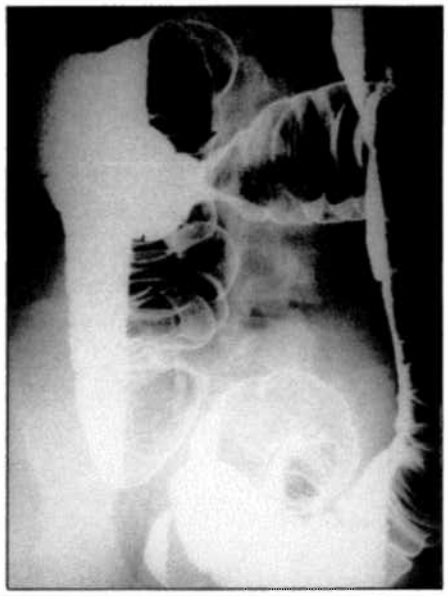
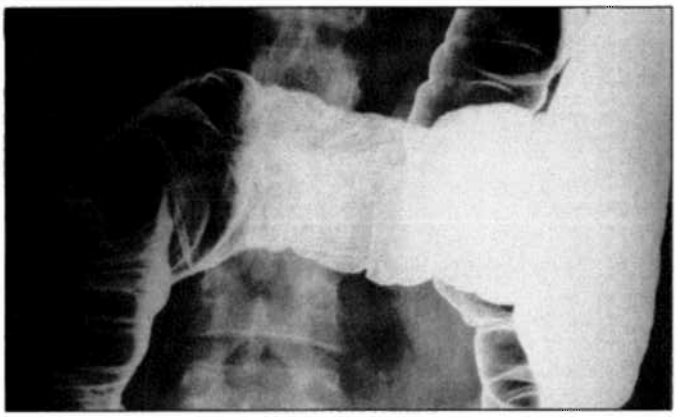


Fig 5.—(Right) Right lateral decubitus radiograph demonstrates a smoothly tapered narrowing in the transverse colon (arrow).

Fig 6.—(Below) The normal haustral folds are absent in the transverse colon and the mucosa is distorted. There is no significant narrowing in this region.



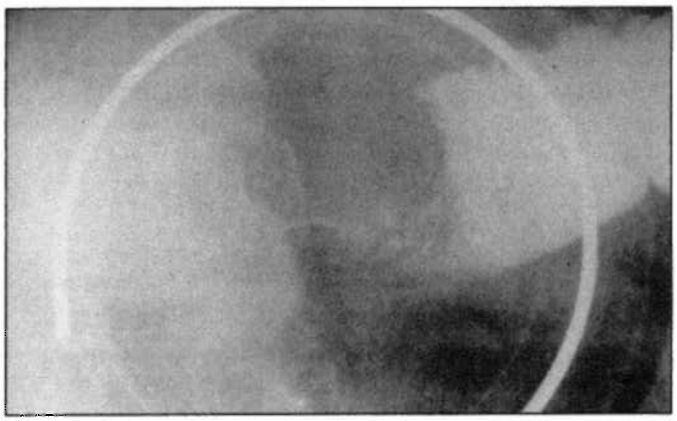


Fig 7.—Spot compression radiograph of the midtransverse colon demonstrates a focal area of narrowing with overhanging edges simulating an *apple core* lesion typical of neoplastic disease.

The rarity of this lesion however requires more detailed reviews to document its roentgenographic appearance.

The sphincter of Moultier is a true sphincter resulting from thickening of both the longitudinal and circular muscle fibers in the mid-sigmoid colon.[4-6] This lesion was located in 6 patients and presented as a focal area of narrowing (Fig 12).

The patient in Fig 12 had right lower-quadrant pain. We did

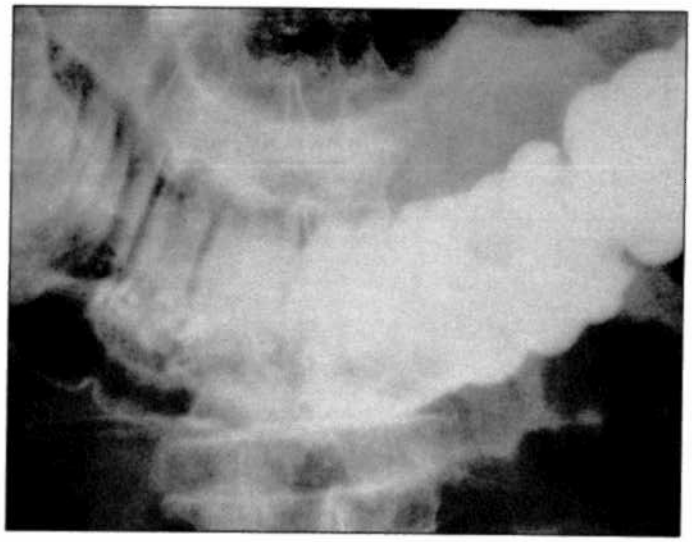


Fig 8.—Radiograph of the transverse colon of the Fig 12 patient 24 hours later with a repeated barium enema examination shows resolution of this suspected abnormality confirming the presence of a sphincter as the original cause of narrowing.

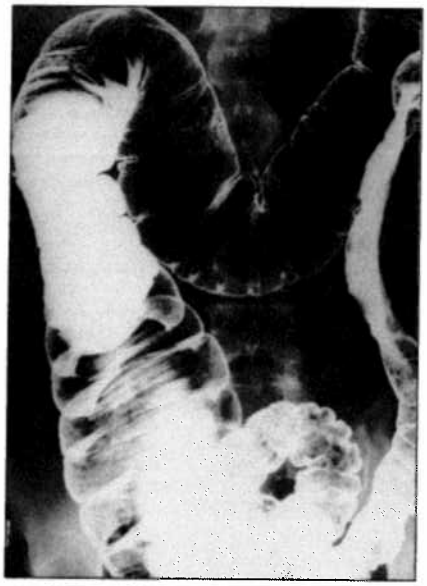


Fig 9.—Abdominal radiograph in the supine position demonstrates an abrupt transition between the normal caliber and significantly narrowed abnormal appearing colonic segment in the splenic flexure. This abnormality also involves a large portion of the descending colon.

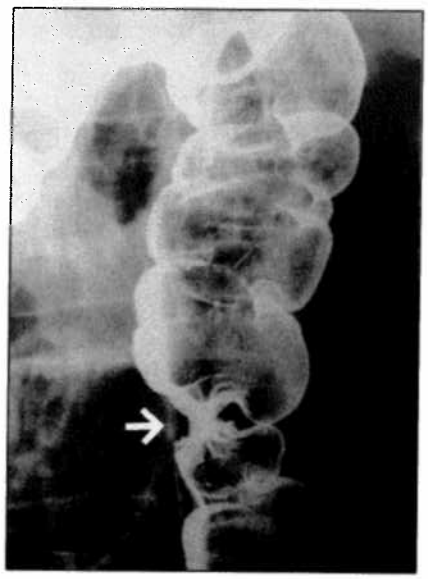


Fig 10.—A focal area of narrowing is present without muscosal ulceration or irregularity on this spot image of the splenic flexure (arrow).

not identify any evidence of mucosal ulceration and the area of narrowing in the sigmoid colon did not change throughout the study. Glucagon in a 0.5 mg intravenous dosage was prescribed and within minutes the lesion resolved.

The sphincter of Rossi was found in 4 patients and varied from a focal (Fig 13) to a more diffuse area of narrowing (Fig 14). This sphincter is functional and without anatomic etiology.[2]

In conclusion, we have reviewed a series of barium exams and report on the frequency of certain colonic sphincters along with the reported etiologies and radiographic appearances.

Knowledge of the expected locations and appearances of these sphincters with close attention to patient clinical history can direct the radiologist to manipulate the position of the patient, insufflate more air or administer glucagon; these steps can help differentiate between a sphincter and organic disease thereby preventing unnecessary intervention.

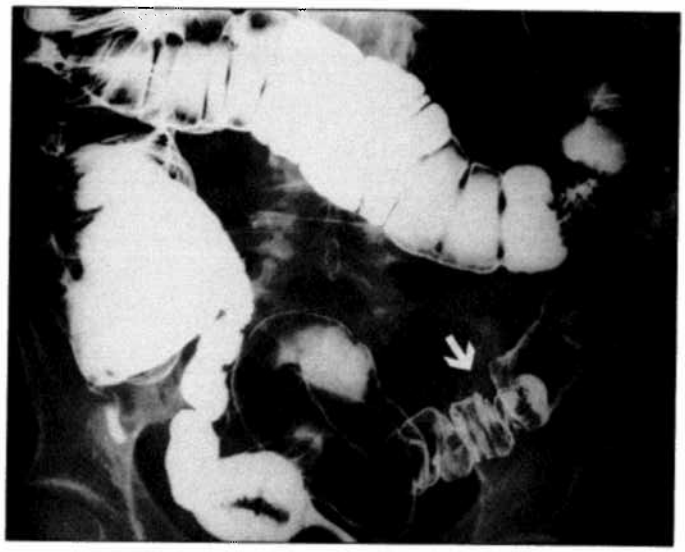


Fig 11.—A persistent narrowing (arrow) is present in the sigmoid region.

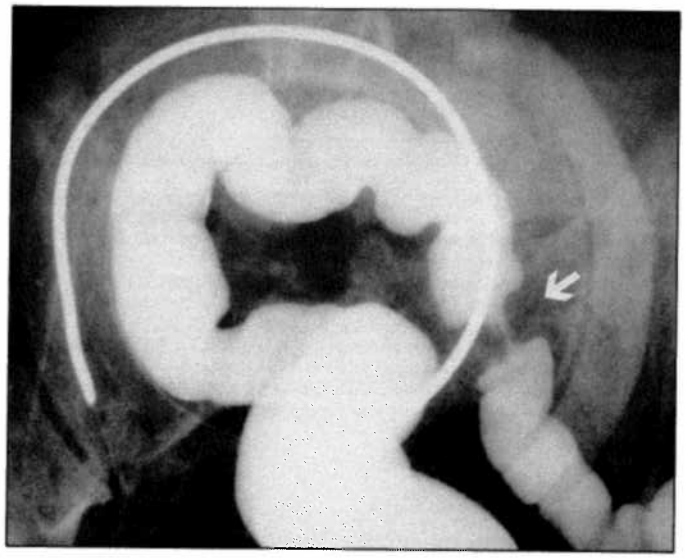


Fig 12.—This spot compression radiograph demonstrates an area of narrowing in the sigmoid colon (arrow) with definite overhanging edges and sharp transition from the normal and abnormal bowel.

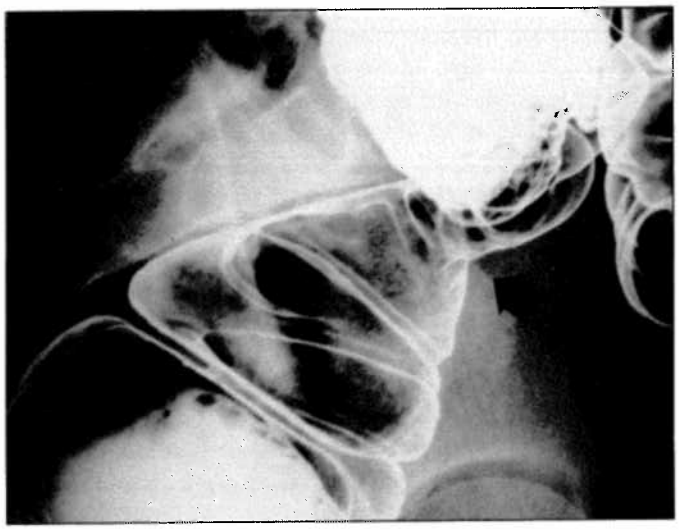


Fig 13.—Lateral radiograph of the rectosigmoid region demonstrates a smoothly tapered area of narrowing (arrow).

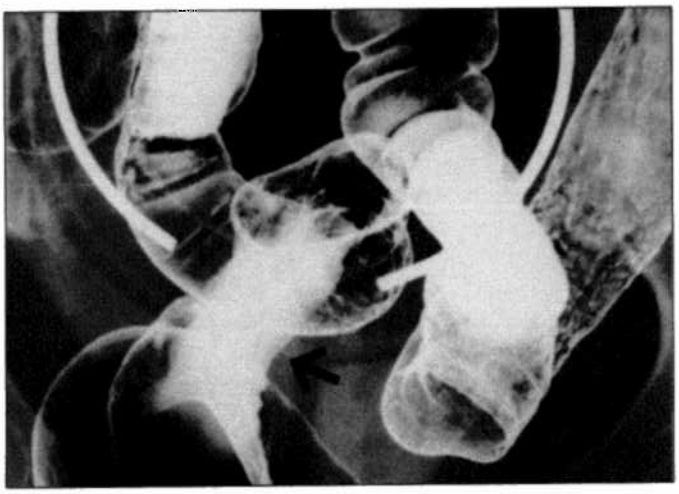


Fig 14.—Frontal spot radiograph with compression of the sigmoid colon demonstrates an area of narrowing (arrow) that involves a larger segment of bowel than the previous example.

Acknowledgment

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